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ABSTRACT

This case study examined the benefits and costs of instructional television as employed by the Education Network of Maine (ENM) through its distance learning initiative. Data were obtained from the 1995-96 and 1996-97 academic years. In fall term 1996, there were 3,264 students enrolled in network courses, about 10.6 percent of system enrollment. A total of 779 students who were enrolled in 23 network courses at either a receiving site (remote) or a studio broadcast site (where students were in the classroom with the instructor) during spring 1996 were surveyed. It was found that responses from both sites were generally favorable toward the courses and the logistical arrangements. A significant difference in average grades was found in only one course. Cost estimates indicated that classroom instruction was the least expensive mode for low enrollment courses (25 students), and that the costs of moderate enrollment courses (110 students) were essentially equal for classroom and network instruction. In high demand courses (220 students), network instruction was estimated to be 47 percent less expensive than classroom instruction. (MDM)

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The Education Network of Maine: A Case Study in the Benefits and Costs of Instructional Television

California State Univ

This report is one of a series from a project entitled *Case Studies in Evaluating the Benefits and Costs of Mediated Instruction and Distributed Learning*. The project is funded through a Field-Initiated Studies Educational Research Grant by the National Institute on Postsecondary Education, Libraries, and Lifelong Learning, Office of Educational Research and Improvement, U.S. Department of Education with additional funding provided by Information Resources and Technology in the Chancellor's Office of the California State University. The project is jointly sponsored by the California State University, the National Learning Infrastructure Initiative of EDUCAUSE, and the State Higher Education Executive Officers. Grant Award No. R309f60088. 1998

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The Education Network of Maine: A Case Study in the Benefits and Costs of Instructional Television

Summary, Findings and Conclusions

1. The Education Network of Maine (ENM) began in 1986 when the Board of Trustees of the University of Maine System and the campus presidents agreed to implement instructional television as a way to improve educational access, especially to the state's rural and placebound residents. From 1986 to 1994 the network was operated by the University of Maine at Augusta (UMA). In 1995 the Education Network of Maine was established as a separate provider of distance learning television services. In 1997, after this case study had been undertaken, the ENM was merged into the University of Maine System Network for Education and Technology Services (UNET) administratively attached to the systemwide Chancellor's Office. The data upon which this report is based are taken from the 1995-96 and 1996-97 academic years.

2. The initiative to develop the distance learning network is consistent with the University of Maine System's mission as "the major instrument of statewide educational, economic, technological, social, and cultural advancement." The mission statement for the ENM is consistent with the System's mission and is specific in its objective of using "the synergy of telecommunications, information, and human resources to bring education of high quality and affordable cost to the community, home and the workplace" and "to extend educational access."

3. The network's physical plant consists of a fiber optic network connecting all the campuses of the University of Maine System augmented by microwave channels and cable television feeds that virtually blanket the state. The network center, located on the Augusta campus, includes four studio classrooms and satellite up- and down-links. The other campuses all have at least one fully equipped studio classroom. The network also operates ten "centers" where students can participate in the interactive (one-way video, two-way audio) instructional television (ITV) and computer based courses. Approximately 100 additional designated receive sites at technical colleges, high schools, and various work locations also are provided some technical support from the network. In 1996 over 3,200 students were enrolled in network courses.

Learning Outcomes, Course Comparisons, Spring 1996

4. Students enrolled in 23 network courses at both receiving and studio broadcast sites during spring 1996 were surveyed using questions developed by the Flashlight Project. Responses of students at the receive sites were generally favorable toward the courses and the logistical arrangements. The only statistically significant difference between broadcast site (students in the TV studio classroom with the instructor) and receive site student responses was that broadcast students indicated they had better access to the library and bookstore.

5. Grade data were also compared for these courses. Analysis was conducted to determine if student grade performance differed, on average, between those who were enrolled at broadcast locations and those at receive sites. A statistically significant difference in average grades between broadcast and receive site students (in favor of broadcast site students) was found in only one course. Of the remaining 17 courses for which sufficient data were available to conduct a "t" test, the differences in average grades were not statistically significant. It should also be noted, however, that out of the 17 comparisons made, only six courses had a mean grade difference that favored receive site students.

Learning Outcomes, Course Comparison, 1996-1997

6. An introduction to anthropology course was offered through the Education Network of Maine in fall 1996 and spring 1997. The fall version of the course was offered on the network in the regular ITV format. All of the class sessions were videotaped. A total of 190 students were enrolled in the course, some at the live broadcast studio in Augusta, the rest located at 13 receive sites throughout the state. A survey was conducted to determine if there were statistically significant differences between broadcast and receive site students with respect to satisfaction with the course. Of particular note was the finding that students in the receive sites felt more strongly than those in the broadcast classroom that the delivery quality was adequate to allow them to learn the content. Students at the receive sites agreed that they would take another course if it were offered in this mode and that they would recommend the course to another student. Overall, receive site students appeared to be more satisfied with the course than those at the sending site.

7. During the spring term the same anthropology course was offered in an asynchronous delivery mode wherein the videotapes of the fall classes were used to deliver the course to a group of 50 students at various receive sites. In addition to viewing the videotapes, students met with the faculty and other students using a telephone conferencing system for review sessions. The same survey used in the fall term was administered to the students who took the videotape version of the course during spring term. The fall term receive site student responses were compared to the responses of the spring term students (all of whom were deemed to be at receive sites). There were no significant differences between the responses of the students in the live network version and the videotaped version of the course. Based upon these survey responses, there is no evidence that receive site students preferred the live network course over the videotape version of the same material.

8. The implication of this result is that students are neutral between a live presentation and one that is provided to them as a set of videotapes. A similar type of result has been observed in another study in this series—the Rensselaer Polytechnic Institute case study where respondents indicated a preference for course materials on videotape over videoconferencing. If these results are real, the implication is that the convenience of the

videotapes, which are truly available anytime, anyplace, and which can be viewed more than once, makes up for the loss of the live presentation. Improving "convenience" for students may not appear to be an important public policy objective. For adult students with work or family responsibilities, however, such improvements in convenience are equivalent to improving "access" to education, something that is considered to be an important policy objective.

Student Access

9. In fall term 1996, there were 3,264 students enrolled in network courses (approximately 10.6 percent of system enrollment). To provide an estimate of the effects the convenience of the network courses may be having upon access, two groups of students were removed from this total: 687 who were also taking courses on campus - on the rationale they already have access to a campus, and 567 who were age 22 or less - on the rationale the youngest students are more mobile and less likely to have work or family responsibilities. The adjusted total is 2,010 students, which represents 6.5 percent of system enrollment for whom access has been improved by the ENM.

10. An estimate of the systemwide participation rate for the state's 18-64 population in 1996 suggests that the availability of network courses has increased the state's participation rate from 3.33 per cent to 3.59 percent, a relative increase of over 7 percent (=3.59/3.33).

Costs

11. Costs were estimated for a course based upon three alternative modes of delivery: instructional television, sending instructors to several remote sites, and on-campus classroom instruction; and for three different levels of course enrollment: low demand courses (enrollment of 25), moderate demand courses (enrollment of 110), and high demand courses (enrollment of 220).

12. The "send instructors to remote sites" alternative has never been proposed as a way to reach placebound students in remote sites. It is used here to illustrate the substantial cost advantage of on-campus instruction (wherein students come to the instructor) over sending instructors to students at several remote sites.

13. Classroom instruction is the least expensive mode for low enrollment courses (about 80 percent less expensive than the alternatives). At current levels of network utilization (approximately 70 percent), the costs of the moderate enrollment course are essentially equal for classroom and network instruction. If network utilization were closer to capacity, network instruction would be slightly less expensive than classroom. For high demand courses, network instruction is less expensive than classroom instruction (by about 47 percent).

14. These cost estimates illustrate that network instruction is subject to scale economies. Because of the start-up and fixed costs associated with network courses, they are more expensive than classroom instruction for courses with relatively small enrollments. As course enrollments grow, spreading the fixed costs over a larger and larger enrollment base, network instruction becomes less expensive than classroom instruction.

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Background and Context

Missions: The University of Maine System and the Education Network of Maine

The Education Network of Maine (ENM) had its origins in 1986 when the Board of Trustees of the University of Maine System and the campus presidents agreed to implement instructional television (ITV) as a way to improve educational access, especially to the state's rural and placebound residents (older students with jobs or family responsibilities).

From 1986 to 1994 the network was operated by the University of Maine at Augusta (UMA). In 1995 the Education Network of Maine was established as a separate provider of distance learning services. In 1997, after this case study had been undertaken, the ENM was merged into the University of Maine System Network for Education and Technology Services (UNET) administratively attached to the systemwide Chancellor's Office. UNET is currently offering seven associate degree programs, five bachelor's programs, two master's programs, three undergraduate certificates and four graduate certificates. The data upon which this report is based are taken from the 1995-96 and 1996-97 academic years.

The distance learning initiative is consistent with the System's mission which, in part, states:

> The University of Maine System is the major instrument of statewide educational, economic, technological, social, and cultural advancement. It serves as a critical resource for the State, linking growth, the education of its people, and the application of research and scholarship upon which human progress and prosperity depend. The System regularly identifies, as its current system goals, important societal and educational needs of the State and responds to them through the educational, research, and public service programs of its campuses as appropriate to individual campus missions. (adopted by the Board of Trustees, effective September 1991)

The mission statement for the Education Network of Maine is specific in its objective of using

> "the synergy of telecommunications, information, and human resources to bring education of high quality and affordable cost to the community, home and the workplace" and "to extend educational access."

Given the relatively severe winters in some parts of the state, the access provided by the network takes on additional meaning as snowbound becomes a component of placebound.

The Network

Initial funding for the network was provided by a federal grant of approximately $3.2M for equipment that was initially augmented by the state in the amount of $2M for an operating budget to start the network (some of the state funding was committed for debt financing which has been repaid).

The network's physical plant consists of a fiber optic network connecting all the campuses of the University of Maine System augmented by microwave channels and cable television feeds that virtually blanket the state.

The network center, located on the Augusta campus, includes four studio classrooms and satellite up- and down-links. The other campuses all have at least one fully equipped studio classroom. The ENM also operates ten "centers" where students can come to participate in the interactive (one-way video, two-way audio) ITV or network courses. Regular live classroom courses are also offered at the centers by faculty from the neighboring campuses. Approximately 100 additional designated receive sites at technical colleges, high schools and various work locations also are provided some technical support from ENM. As shown in Table 1, enrollment in the network courses has grown since 1989 to over 3,000 students. This growth has occurred during a period in which the system's enrollment has shown slight declines.

Table 1—Fall Enrollments, University of Maine System and Education Network of Maine—Instructional Television Component

Fall Term	Systemwide Total	Instructional TV (receive sites only)
1989	33,767	1,451 (estimated)
1995	31,115	2,906
1996	30,931	3,264

Sources: *Summary of Fall Enrollments, University of Maine System*, Fall 1995, Fall 1996, Office of Finance and Treasurer.

Notes:
Since 1995 all network enrollments are counted at the campus that originates the course.
The network enrollments are for receive sites only. Students attending the course in the live studio classroom are counted as regular enrollments.

Benefits

Learning Outcomes

Courses Offered Spring Term 1996

Student Surveys

The Education Network of Maine was a participant in the Flashlight Project, managed by the Western Interstate Commission of Higher Education and funded by the Annenberg/CPB Project. The broad goal of the Flashlight Project is to develop measures and procedures with which to evaluate the use of mediated instructional technologies in higher education. "The primary goal of the Flashlight Project is to focus attention on selected dimensions of those principles of 'good practice' in teaching and learning that are supported in instruction by the use of technology (such as computers, video, telecommunications, etc.). A student survey item bank has been developed which focuses on five of AAHE's seven principles of 'good practice' in undergraduate education: student-faculty interaction, cooperation among students, active learning, prompt feedback, and time on task. In addition, the bank includes measures of direct and indirect outcomes: self-reported cognitive and behavioral outcomes, and student retention" (adapted from *Tools for the Local Evaluation of Educational Uses of Technology*, WICHE, January 1996, p. 2).

Using the Flashlight survey item bank, a student survey was designed to obtain information related to the level of student satisfaction with courses delivered by the ENM using interactive television. The 23 courses selected for this study each had four different audience locations: broadcast (or sending) site, community sites, University Center sites, and individual student homes. A total of 1,886 students were enrolled in the courses surveyed during spring term 1996. The courses, their related enrollments, and the number of survey respondents are shown in Table 2.

Table 2—Course Enrollments for Flashlight Student Survey, Spring 1996

Course	Course Name	Enrollment	Survey Respondents
ANTO 210	Physical Anthropology	37	12
ARTA 106	History of Art & Architecture II	89	36
BUAA 253	Principles of Investment	32	11
BUAA 290	Business and Public Policy	11	4
BUAA 360	Production Management	23	13
COSA 227	Data Communications	40	14
ENGA 101	College Writing	60	33
ENSA 110	The Human Environment	19	8
LIBA 100	Intro to Libraries & Library Careers	36	20
LIBA 250	Orientation to Collection	53	31
MATA 112	College Algebra	24	6
MATA 115	Statistics I	251	110
MLCO 190	Multiculturalism	31	0
MUSA 123	Understanding Music	74	34
NURP 699	Advanced Psychopharmacology	36	24
PHIA 103	Introduction to Philosophy	160	63
PSYA 100	Introduction to Psychology	218	75
PSYA 220	Psychosocial Rehabilitation	112	51
PSYA 229	Models of Addiction	81	23
PSYA 308	Human Development	200	79
SEDP 682	Special Education Law	137	58
SOSA 101	Introduction to Social Service Systems	125	55
SOSA 289	Supportive Family Practices	37	19
Total		1,886	779

Surveys were mailed to students during the tenth week of classes. A follow-up reminder postcard was sent two weeks later to individuals who had not responded. Seven hundred seventy-nine usable surveys were returned for a response rate of 41 percent.

An analysis of student satisfaction was conducted based upon the survey responses. The survey respondents scored items on a five-point scale as follows:

1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

Mean responses were calculated and interpreted as follows:

1.00 to 1.50 = strongly disagree
1.51 to 2.50 = disagree
2.51 to 3.50 = neutral
3.51 to 4.50 = agree
4.51 to 5.00 = strongly agree

The results are shown in Table 3.

Responses to statements that apply only to receive site students were not tabulated for broadcast site students. If the mean response for both groups fell within the same response category, the score with the highest value is shown with a "+."

T-tests were used to determine if there were statistically significant differences in the responses of students located at the broadcast (or sending) site with the professor present and those located in the receive sites including community sites, University Centers, and student homes. Significant differences in the mean responses (at the 5 percent level at least) are indicated by a "yes" in the last column of the table. Few differences were found. Generally, students responded positively. Students at the broadcast site agreed more strongly than receive site students that they had adequate access to library resources and the bookstore. This is not surprising since both the bookstores and libraries are located on the campuses. Both groups were about equally satisfied with academic advising and tutoring services.

Table 3—Student Satisfaction Based upon Survey Responses, Spring 1996

Item	Broadcast Site	Receive Sites	Significant Difference?
The site coordinator and/or center leader was very helpful.	na	agree	-
It was easy to contact the site coordinator/ center leader when I had a problem.	na	agree	-
The site coordinator/center leader has helped me stay in school.	na	neutral	-
It was easy to deal with financial aid from a distance.	na	neutral	-
I had adequate access to library resources.	agree+	agree	yes @1%
I had adequate access to the bookstore.	agree+	agree	yes @1%
I was satisfied with the academic advising I received.	neutral	agree	no
I had adequate access to academic tutoring services.	agree	neutral	no
I planned specific study times this term and stuck to the schedule.	neutral+	neutral	no
My course schedule conflicted with my work and/or family responsibilities this term.	neutral+	neutral	no

na - not applicable

Grade Comparisons

In addition to survey data, grade data were also compared for the courses. Analysis was conducted to determine if student grade performance differed, on average, between those who were enrolled at broadcast locations and those at receive sites. Table 4 presents the findings for each course. A statistically significant difference in average grades between broadcast and receive site students (in favor of broadcast site students) was found in only one course (ANTO 210, Physical Anthropology). Of the remaining 17 courses for which sufficient data were available to conduct a "t" test, the differences in average grades were not significant. It should also be noted, however, that out of the 17 comparisons made, only six courses had a mean grade difference that favored receive site students.

Table 4—Course Grades at Broadcast and Receive Sites, Spring 1996

Course	Broadcast Site		Receive Sites		Significant Difference?
	n	mean grade	n	mean grade	
ANTO 210	8	3.67	22	2.53	yes @ 5%
ARTA 106	14	3.38	64	2.97	no
BUAA 253	3	1.11	24	2.21	no
BUAA 290	0	—	1	.67	—
BUAA 360	6	3.33	15	3.16	no
COSA 227	4	2.84	28	3.20	no
ENGA 101	8	3.00	41	2.89	no
ENSA 110	2	3.17	11	2.91	—
LIBA 100	0	—	27	3.69	—
LIBA 250	4	3.34	44	3.40	no
MATA 112	7	2.81	10	2.97	no
MATA 115	19	3.58	187	3.20	no
MLCO 190	1	4.00	23	2.88	—
MUSA 123	9	3.04	60	3.10	no
NURP 699	10	3.67	19	3.40	no
PHIA 103	8	2.92	57	2.31	no
PSYA 100	13	2.77	139	2.57	no
PSYA 220	12	2.86	113	2.62	no
PSYA 229	8	2.92	57	2.31	no
PSYA 308	23	2.70	160	2.77	no
SEDP 682	26	3.82	100	3.53	no
SOSA 101	13	3.69	62	3.74	no
SOSA 289	2	1.50	29	3.52	—

Note: Due to the large difference in the site enrollments, the pooled variance estimate was used rather than separate variance estimates.

Introduction to Anthropology, 1996-1997

An introduction to anthropology course was offered through the ENM in fall 1996 and spring 1997. The fall version of the course was offered on the network in the regular ITV format using one-way video and two-way audio. All of the class sessions were videotaped. A total of 190 students were enrolled, some at the live broadcast studio in Augusta, the rest located at 13 receive sites throughout the state.

Table 5 presents results from a survey for students enrolled in the fall 1996 ITV version of the course. Of the 190 students who were enrolled, 25 percent returned a completed survey (15 were from students at the broadcast site, 33 from students at receive sites).

Respondents scored the survey items on a six-point scale from 1= strongly disagree to 6 = strongly agree. Mean responses to the items were calculated and were interpreted for the table as follows:

1.00 to 1.50 = strongly disagree
1.51 to 2.50 = disagree
2.51 to 3.49 = somewhat disagree (sm disagree)
3.50 = midpoint (neutral)
3.51 to 4.50 = somewhat agree (sm agree)
4.51 to 5.50 = agree
5.51 to 6.00 = strongly agree

If the mean response for both groups fell within the same category, the score with the highest value is shown with a "+."

Table 5–Introduction to Anthropology–Student Satisfaction Based upon Survey Responses, Fall 1996

Item	Broadcast Site	Receive Sites	Significant Difference?
I was satisfied with the registration process.	sm agree	agree	yes @1%
The information I received during registration about this course was accurate.	neutral	agree	yes @1%
The information I received during registration about this course was helpful.	sm disagree	sm agree	yes @1%
I was able to obtain course materials and books in a timely manner.	agree	agree+	no
The course syllabus was clear.	sm agree	agree	yes @1%
I was satisfied with the pace at which the instructor taught the course content.	sm disagree	sm agree	yes @5%
I was satisfied with the instructor's organization of the class sessions.	sm disagree	sm agree	yes @1%
I was satisfied with the instructor's explanation of concepts.	sm disagree	sm agree	yes @1%
The graphics the instructor used helped to clarify course content.	sm disagree	sm agree	yes @1%
I was satisfied with the timeliness of interaction with the instructor (when I needed assistance).	sm disagree	sm agree	yes @5%
The instructor made me feel like my questions and comments were important.	sm disagree	sm agree	yes @5%
The instructor's responses to my questions and concerns were helpful.	sm disagree	sm agree	no
I felt "connected" to other students taking the course.	sm disagree	sm disagree+	no
I was satisfied with the instructor's office hours.	agree	agree+	no
Corrected tests and assignments were returned in a timely manner.	agree	agree+	no
I was satisfied with the quality of the audio.	na	agree	-
I was satisfied with the quality of the video.	na	agree	-
Overall, the delivery quality was adequate to allow me to learn the content.	disagree	agree	yes @1%
I felt the workload for this course was comparable to that in other courses I have taken at this level.	sm agree	agree	no
I would take another course if it were offered in this mode.	sm disagree	agree	yes @1%
I would recommend this course to another student.	disagree	sm agree	yes @1%
Overall, I was satisfied with this course.	sm disagree	sm agree	yes @1%

T-tests were conducted to determine if there were statistically significant differences between broadcast and receive site students with respect to satisfaction with the course. Significant differences in the mean responses (at the 5 percent level at least) are indicated by a "yes" in the last column. Receive site students (as a group) were more satisfied with various aspects of the course. Of particular note was the finding that students at the receive sites felt more strongly than those in the broadcast classroom that the delivery quality was adequate to allow them to learn the content. Students at the receive sites agreed that they would take another course if it were offered in this mode and that they would recommend the course to another student. Overall, receive site students appeared to be more satisfied with the course than those at the sending site.

During the spring term the same anthropology course was offered in an asynchronous delivery mode wherein the videotapes of the fall classes were used to deliver the course to a group of 50 students at various receive sites. In addition to viewing the videotaped lectures and discussions of the previous semester, students met with the faculty and other students using a telephone conferencing system (a 26-line telephone bridge) for review sessions. These students took scheduled exams at designated sites or centers.

The same survey used in the fall term was administered to the students who took the videotape version of the course during spring term. A total of 32 usable surveys were obtained. The fall term receive site student responses as shown in Table 5 were compared to the responses of the spring term students (all of whom were deemed to be at receive sites). The comparison data are not presented here because there were no significant differences between the responses of the students in the live network version and the videotaped version of the course. Based upon these survey responses, there is no evidence that receive site students preferred the live network course over the videotape version of the same material. (In spite of the fact that there were no significant differences in the mean response values, the videotape students gave higher average scores on 15 of the 22 survey items.)

The implication of this result is that students are neutral between a live presentation and one that is provided to them as a set of videotapes. A similar type of result has been observed in another study in this series—in the Rensselaer Polytechnic Institute case study, respondents actually indicated a preference for course materials on videotape over videoconferencing.[1] If these results are real, the implication is that the convenience of the videotapes, which are truly anytime, anyplace, and which can be viewed more than once, makes up for the loss of the live presentation. Improving "convenience" for students may not appear to be an important public policy objective. For adult students with work or family responsibilities, however, such improvements in convenience are equivalent to improving "access" to education, something that is considered to be an important policy objective.

[1] *The Human Computer Interaction Certificate Program at Rensselaer Polytechnic Institute: A Case Study in the Benefits and Costs of a Joint Industry/University Designed Program Featuring Integrated Delivery Methods*, see esp. Table 3, page 17. This case study is available at the benefit cost project website <www.calstate.edu/special_projects/> and through the ERIC Clearinghouse on Higher Education.

Student Access

Maine's population in the 1990 census was 1,228,000 individuals. In 1995 the total population was estimated to be 1,241,000. It is projected to grow to 1,285,000 in the year 2005.[2] This modest growth of the total population is reflected in the projections for the cohort aged 18-24 which is projected to remain essentially stable between 1995 and 2005 (at 112,000). The only cohort projected to grow is the 25-64 group which increases from 651,000 to 716,000 (+10 percent) in the ten-year period.[3] For the University of Maine System, the challenge into the next century will be to provide access for the residents of the state with a constant or slightly declining state appropriation.

Table 6 provides information on the characteristics of students taking network courses at receive sites for fall 1996.[4] Of the 3,264 students involved, 79 percent were taking network courses only, 92 percent were part-time, 99 percent were in-state, 78 percent were women, and 60 percent were over the age of 30. The small percentage of students seeking a baccalaureate or higher degree suggests that a large number of the students are seeking job-related skills that are directly relevant to their current employment or to current employment opportunities.

The question is whether the network course offerings have had an effect upon access by providing educational opportunities to groups of individuals who otherwise would not have participated in higher education. To address this question the network course enrollment data in Table 6 are compared with total system enrollments for 1995 and 1996 as shown in the top panel of Table 7. Students enrolled in at least one network course accounted for over 10 percent of the University of Maine System total enrollment and 4.5 percent of system FTE in 1996. Given that network course enrollments and FTE have expanded in a period when systemwide enrollments have either declined or remained stable suggests that at least a segment of the student population finds the network option attractive.

[2] U.S. Census Bureau, WWW Homepage, State Population Projections by Age and Sex 1995-2025.
[3] This latter age group accounts for a substantial part of network enrollment (see Table 6, below).
[4] The data are for receive site students only. Students enrolled at the sending or broadcast site are excluded.

Table 6—Total Receive Site Enrollment in ITV (Network) Courses and Selected Student Characteristics, Fall 1996

	Number	Percent
Total Enrollment	3,264	100%
Student Characteristics		
taking network courses only	2,577	79%
taking network and on-campus courses	687	21%
full-time students	319	8%
part-time students	2,945	92%
in-state	3,236	99%
out-of-state	28	1%
men	709	22%
women	2,555	78%
age 22 or less (see note 1 below)	567	17%
age 23-30	752	23%
age 31 or more	1,935	59%
Educational Objective		
Baccalaureate or graduate degree	274	8%
Associate degree	936	29%
Non-degree	2,027	62%

Source: *Summary of Fall 1996 Enrollments, University of Maine System*, Office of Finance and Treasurer, "Supplemental Report on ITV Students," pp. 20-21.

Notes:

1. Age was not reported for ten students.
2. Percentages may not add due to rounding.
3. All enrollment and FTE in network courses is counted at the campus originating the course.

One approach to the access issue is to inquire what groups of students would be most affected if the network option had not been available. In such a situation the students taking network courses would have had two alternatives, either to take the courses on campus or to not participate.

Students who are enrolled in regular on-campus courses also enroll in network courses. Although the network course may provide a convenience for these dual enrollment students, it is unlikely the availability of the network option has much of an effect upon access because these students could probably take the course on campus if it were not available in any other way. The third panel in Table 7 shows that the over 2,500 students who are taking network courses only comprise 8.3 percent of systemwide enrollment and 3.6 percent of FTE.

Finally, the fourth panel of Table 7 reduces the affected pool further by eliminating the 567 students younger than 23 years of age.[5] The rationale for this adjustment is that younger individuals are less likely to have employment or family commitments and are therefore more mobile, i.e., in a better position to "go away to school."

Table 7—University of Maine System and Network Course Enrollments

	Fall 1995		Fall 1996	
University of Maine System				
Total Students	31,115		30,931	
Total FTE	20,301.4		20,293.5	
Enrolled in courses provided through ENM		**Percent of Systemwide**		**Percent of Systemwide**
All students taking network courses	2,906	9.3%	3,264	10.6%
FTE	804.0	4.0%	921.9	4.5%
Students taking network courses only	2,168	7.0%	2,577	8.3%
FTE	597.6	2.9%	730.3	3.6%
Students 23 years and older taking network courses only	1,836	5.9%	2,010	6.5%

Source: *Summary of Fall Enrollments, University of Maine System, Fall 1995, Fall 1996,* Office of Finance and Treasurer, October 1995, October 1996, Charts 1, 4, and "Supplemental Report on ITV Students," pp. 20-21.

This last adjustment shows that over 2,000 individual students could be negatively affected by the loss of the network option. To state this conclusion in a positive way, the creation and subsequent growth of the network delivery capability was, by fall 1996, providing access to higher education for as many as 2,000 individuals (about 6.5 percent of systemwide enrollment) who otherwise might not have participated.

[5] The adjustment may be somewhat overstated to the extent some of the younger than 23-year-olds were included in the group taking both network and on-campus courses that was eliminated previously.

Statewide Participation Rates

In addition to estimating the impact of network courses upon systemwide enrollment, it is also possible to estimate effects of the network courses upon statewide participation rates, i.e., the share of the Maine age cohort that are students in the University of Maine System. The data for the calculation are provided in Table 8.

Table 8—Estimated Impact of Network Courses upon Statewide Participation Rates

Age Group	**Maine Population 1996 (est.)**
18-24	112,000
25-64	657,500
Total (18-64)	769,500
	University of Maine System
Enrollment fall 1996	30,931
Less out-of-state students	3,337
In-state enrollments	27,594
Statewide participation rate *including network* enrollments	0.0359 = 27,594/769,500 (about 3.59% of the state's 18-64 population)
	Adjustments for Network Enrollments
Students 23 and older taking network courses only	2,010 (from Table 7)
Out-of-state students enrolled in network courses	28 (from Table 6)
Network students less out-of-state	1,982
In-state enrollments less network	25,616
Statewide participation rate *excluding* network enrollments	0.0333 = 25,616/769,500 (about 3.33% of the state's 18-64 population)

Sources: Maine population estimates see footnote 2.
University of Maine System same as Table 6.

The estimated effect of network enrollments is to change the 1996 participation rate from 3.33 percent to 3.59 percent. This difference, 0.26 of a percentage point, accounts for over 7 percent of the state's total participation rate.

Costs

Estimates of the direct costs of providing network courses to students are developed and compared with the costs of on-campus classroom instruction and the costs of sending instructors to students located at remote sites.[6]

Estimated Direct Costs for Network Courses

Network Operating Costs

The annual operating budget for the network is approximately $6,715,000. Expenditures for fiscal 1997 were distributed as shown in Panel I of Table 9. These expenditures include an item for the ten off-campus centers and approximately 100 other receive sites where students can participate in the network courses. The centers were developed in the 1970s prior to the advent of television delivery via the network and continue to be used for regular classroom courses taught by faculty from local campuses. The centers are staffed to provide a full range of student support and counseling services similar to those available at the campuses. Network staff estimate that the center/site costs increased by approximately 20 percent with the advent of the ITV delivery mode. This increase represents technical staff and equipment costs related to ITV delivery; it does not include the student support costs associated with the ITV enrollments because these costs would have been incurred whether the enrollment was in regular live courses or in ITV courses at the centers/sites.

In Panel II of the table, 16.7 percent of the centers'/sites' costs (approximately $326,000) are shown as the additional costs that can be attributed to network courses.[7] This adjustment removes costs associated with the 49 percent of all courses offered in these locations that were regular live classroom courses and the student support costs associated with the ITV courses. Panel II also shows the last five cost categories from Panel I aggregated to a total $3,253,000 under the heading of Instructional Support.

In fall 1995 ENM listed 80 ITV network courses; by spring 1997 course offerings had increased to 105. Assuming 105 courses per semester plus 53 courses in the summer results in a total of 263 courses provided via the ITV network per year. Allocating network operating costs based upon this level of utilization results in an estimate of $19,327 per course as shown in Panel III of the table.

[6] No one has or is proposing the alternative that involves sending live instructors to remote sites as a real possibility. It is included here as a basis for cost comparisons with both network and on-campus courses because it represents a way to improve access for placebound students.

[7] If the current site costs represent the original (pre-ITV) cost plus 20 percent for the network associated costs, network costs represent .2/1.2 or .1667 of the current total.

Table 9—ENM Estimated Expenditures, FY97

I. Category Detail(1)		II. Consolidated Categories	
Administration	$1,234,136	Administration	$1,234,000
Centers/sites	1,958,154	Centers (adj.)(4)	326,000
Computer/Comm. Technology(2)	328,822	Instructional support	3,523,000
Academic Support(3)	1,604,870		
Public Service	1,291,975		
Marketing	48,152		
	248,788		
Total	$6,714,897	Total	$5,083,000

III. Costs per Course @ 263 Courses per Year		IV. Costs per Course @ 380 Courses per Year	
Administration	$4,692	Administration	$3,247
Centers (adj.)	1,240	Centers (adj.)	858
Instructional support	13,395	Instructional support	13,395
Total	$19,327	Total	$17,500

(1) Adapted from Bates and Mingle, January 1997, page 38.
(2) IT&T administration and operating
(3) Includes off-campus library service, teleservice center, academic support, instructional development, academic logistics, etc.
(4) Approximately 16.6 percent of total centers'/sites' cost represents the additional costs of technical staff and equipment related to ITV courses. This adjustment removes costs associated with the 49 percent of courses offered at centers/sites that are regular classroom courses and the student support costs associated with ITV enrollments that would be provided in any event.

The 263 course estimate of network utilization can be compared with the theoretical utilization that would arise if the ITV network was at its maximum capacity of 494 courses (i.e., if 13 studio classrooms were used to capacity at 45 hours per week to broadcast 38 courses per year—15 courses each semester plus 8 in the summer). Because there are only four channels available that blanket the entire state, this level of utilization could only occur if the ITV network were regionalized, allowing the same channel to be used simultaneously to broadcast different courses to different regions of the state. Such a maximum regionalization would have a negative impact upon course enrollments by limiting the regional population from which the individual course enrollments could be drawn. A more conservative estimate of maximum utilization that requires somewhat less regionalization of specific course offerings is 380 courses (based upon 10 simultaneous sites and 38 courses). This latter estimate is used to allocate costs to courses in Panel IV of Table 9, resulting in a per course cost of $17,500. For

purposes of making the per course cost calculation, administration[8] and center costs were held constant on the assumption that these costs are basically fixed and would not be much affected by changes in the number of courses offered. Costs for instructional support will increase as the number of courses increase; consequently, the per course cost of instructional support at 380 courses is assumed the same as the per course cost at 263 courses. The difference between the $19,327 and $17,500 costs in the two panels arises because the fixed administrative and center costs are spread over more courses.

Faculty Stipend - Faculty who teach a network course receive a stipend of $2,500 in addition to their regular pay (see discussion of faculty position costs below). This stipend is to reimburse faculty for the additional preparation effort required when the course is offered on the network. It also pays to some extent for the extra effort associated with larger enrollment network courses.

Additional enrollment costs - Beyond some enrollment level, additional funds may be provided, at the discretion of the campus offering the course, to defray the additional workload associated with grading homework and examinations. Although the practice is not uniform across the campuses, for purposes of these cost comparisons an additional $10 per student is projected for enrollments in excess of 110.

Capital Costs for Network Courses

Capital costs represent the value of the fixed assets (facilities, equipment, and infrastructure) used to produce and distribute the network courses. Once capital assets are purchased their services are used over a period of years. Annual capital costs are based upon imputations that allocate the original costs to individual years over the asset's useful life. As such, these imputed costs are not annual out-of-pocket expenses comparable to annual operating costs. Estimating capital costs is important for comparisons of alternative delivery modes, however, if the intent is to select modes that are viable over the long run. In that case, all of the direct costs, including the direct capital costs, should be accounted for.

The ENM has capital facilities (including equipment and infrastructure) with an estimated value of $16,000,000 obtained over a period of years from both federal grants and state capital funding. Assuming an average useful life of ten years for this capital results in an annual capital cost of $1,600,000 per year. Further assume up to ten studio classrooms are involved (four at Augusta and six operated from other campuses). Allocation of the annual cost to ten broadcast site studio classrooms results in $160,000 per classroom. If studio classroom capacity is 38 courses per year, as discussed above, the annual imputed capital cost is $4,211 per course.

Other Costs Associated with Network Courses

Media professionals, including staff for operation of video equipment in the studio classroom ("switchers"), control room staffing, and line and communications costs are already included in the per course costs contained in Table 9 and are not accounted for separately.

Other Cost Factors

Faculty cost per course section is estimated at $5,800 based upon an average salary of $46,400 and an average annual courseload of eight. This same faculty position cost is used when estimating the costs of all three modes of instructional delivery.

[8] ENM administrative costs are included here as a direct cost of network courses rather than overhead because such costs are directly associated with operation of the network program.

From the standpoint of making cost comparisons, it can be argued that the costs of putting the faculty member into the studio classroom should not be charged against the network course if the course would have been offered to the live on-campus class anyway. In that situation, only the network costs, faculty stipend, and additional enrollment costs should be charged against the remote site enrollments. If the course would not have been offered without the additional enrollments associated with the remote site students, it would be reasonable to include the faculty position cost. To acknowledge that this is not an entirely settled issue, the network course costs shown in Table 10 below are calculated both with and without the faculty position cost.

Faculty travel cost - If faculty had to travel to remote sites to teach a course, it is assumed an average round trip of 60 miles is made once a week for 15 weeks. Mileage is reimbursed at the rate of $0.25 per mile for a total travel cost of $225.

On-campus classroom capital costs per course are estimated at $125-$250 based upon the author's estimate of higher education capital costs and assuming a 30-year useful life for the facility and the equivalent of 24 courses per year.

Materials fee - Students who enroll in network courses are charged a materials handling fee of $5 per credit hour to defray specific costs associated with network delivery. A three-unit course would have a materials fee of $15. In the cost estimates that follow, this fee revenue is shown as an offset against ITV network course costs.

Costs of Three Alternative Delivery Modes

The costs of three alternative delivery modes are estimated: (1) courses offered via the network, (2) courses offered by sending live instructors to remote sites, and (3) classroom courses offered on-campus. In each situation costs are estimated for three levels of course enrollments:

a. *Low demand course* - enrolling 25 students (4-5 in the studio classroom on-campus) For cost reasons that are readily apparent from an inspection of Table 10, use of the network to provide such low enrollment courses is discouraged. The cost calculation is provided here solely for comparison purposes.

b. *Moderate demand course* - enrolling 110 students (10-15 in the studio classroom), and

c. *High demand course* - enrolling 220 students (15-30 in the studio classroom).

For each of the enrollment levels, network costs are estimated based upon the mid-1990s network utilization level of 263 courses and at a capacity of 380 courses. The results are shown in Table 10.

Network course costs are shown both with and without faculty salary costs of $5,800 per course. The other two modes include faculty salary costs; indeed, such costs constitute the major component of the other modes. For the "network" option the operating and capital costs of the network and faculty stipend costs are added and the student materials fee revenue is subtracted to obtain the total institutional cost estimate. The "send instructors to remote sites" option includes faculty and travel costs plus an estimate of the cost of the remote sites where the course would be offered. The "offer course on-campus" option includes faculty costs plus an estimate of the capital value of the classroom allocated to a single course.

Table 10 provides details on how the cost estimates were derived, e.g., for the "send instructors" option it is assumed that five sites with an average enrollment of five are required for the low demand course; for the "offer course on-campus" option it is assumed that five sections with an average enrollment of 22 are required for the medium demand course.

Table 10—Estimated Costs of Network Courses Compared to Sending Instructors to Remote Sites and On-campus Instruction

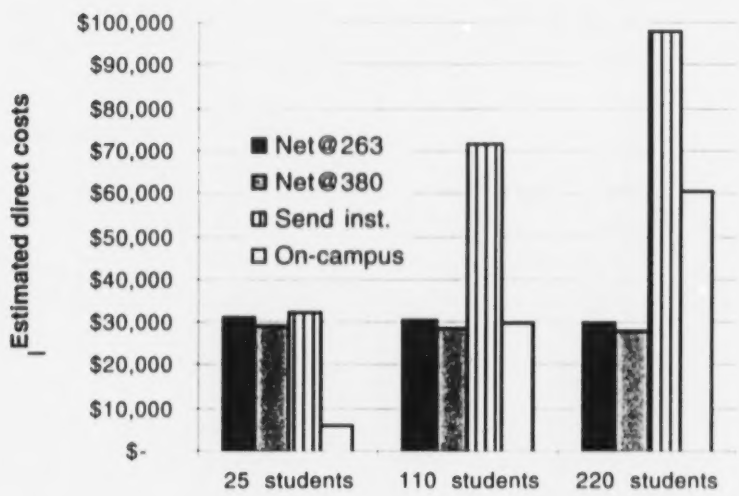
Course Demand	Network (ITV) @ 263 courses/year	Network (ITV) @ 380 courses/year	Send Instructors to Remote Sites faculty $5,800 travel 225 est site cost 500 cost/site $6,525	Offer Course On-campus faculty $5,800 est cap cost 250 cost/sect $6,050
Low demand 25 students				
Network costs				
Operating	$19,327	$17,500		
Capital	4,211	4,211		
Faculty stipend	2,500	2,500	5 sites @ 5 each	one section @ 25
less fees*	(300)	(300)		
Total	$25,738	$23,911		
Total, including faculty salary	$31,538	$29,711	$32,625	$6,050
Medium demand 110 students				
Network costs				
Operating	$19,327	$17,500		
Capital	4,211	4,211		
Faculty stipend	2,500	2,500	11 sites @ 10	5 sections @ 22
less fees*	(1,455)	(1,455)		
Total	$24,583	$22,756		
Total, inc. faculty salary	$30,383	$28,556	$71,775	$30,250
High demand 220 students				
Network costs				
Operating	$19,327	$17,500		
Capital	4,211	4,211		
Faculty stipend	2,500	2,500		
plus enr@$10ea.	1,100	1,100	15 sites@14.7	10 sect. @ 22 each
less fees*	(2,955)	(2,955)		
Total	$24,183	$22,356		
Total, inc. faculty salary	$29,983	$28,156	$97,875	$60,500

* Fees are based upon 20, 97, and 197 students at receive sites, respectively.

One result readily apparent in Table 10 is the efficiency of offering courses in classrooms on-campus compared to sending instructors to remote sites. Arranging to have students come to campus where an instructor could have access to a relatively large number is much less expensive than arranging to have instructors go to the students at several remote sites. The efficiency occurs because aggregating students on-campus results in a larger average class size (e.g., 25 versus 5 for the low demand course) and less duplication of effort.

For low demand courses the network option is about as expensive as sending instructors to remote sites which, of course, serves as a rationale for discouraging use of the network to deliver such courses. The on-campus alternative is much less expensive than either of the other two. As total course enrollment grows to 110, costs of the network alternative are about the same as the on-campus costs (assuming five sections—if four on-campus sections were offered, the on-campus cost would be $24,200). For high demand courses enrolling 220 students, the network alternative can be less expensive than classroom instruction.[9] This result occurs because the fixed costs associated with network courses are spread over a larger student base and the incremental cost of additional enrollment is less for network than for on-campus classroom instruction. Chart I further illustrates the data from Table 10.

Chart I—Costs of Network Courses Compared to Sending Instructors to Remote Sites and On-campus Classroom Instruction



[9] For this specification of costs and total course enrollment, network instruction is less expensive than classroom instruction provided the average section size is fewer than 38.